

Metropolitan Museum of Art
Gas Chromatography- Mass Spectrometry (GC-MS) Results from Material Analysis

This document includes (1) a mass spectrum and (2) the volatile organic compounds (VOCs) emitted from samples using GC-MS analysis. The data is not interpreted; however, several classes of chemicals are highlighted because they are potential risks for artwork in an enclosed environment. A basic key, provided below, indicates those classes. The amount of each chemical identified has not been determined; similarly, it is not known how much of each chemical is necessary to do damage to art. Finally, peaks may be present that are the result of the sample adsorbing chemicals from the air and reemitting them during testing rather than being inherent to the sample. Research is ongoing to determine specifically which chemicals and amounts are required to negatively affect artifacts.

Highlighted data:

Pink – chemicals currently known to be hazardous to art

Green – amines; can raise the pH, are suspected to react with acids and may form crystals in an enclosed environment

Yellow – chemicals of the following type, which *may* be hazardous to art:

Acids – lower the pH, corrosive to metals, degrade organic materials

Aldehydes – can convert to acids with heat or exposure to UV light

Esters – can hydrolyze into acids with heat and humidity

Sulfur-containing compounds – known to tarnish and corrode some metals

Halogenated compounds – can become reactive with exposure to heat and UV light

Nitrogen-containing, not amine – can react with other off-gassed chemicals

Alkynes – can become reactive when exposed to heat or UV light

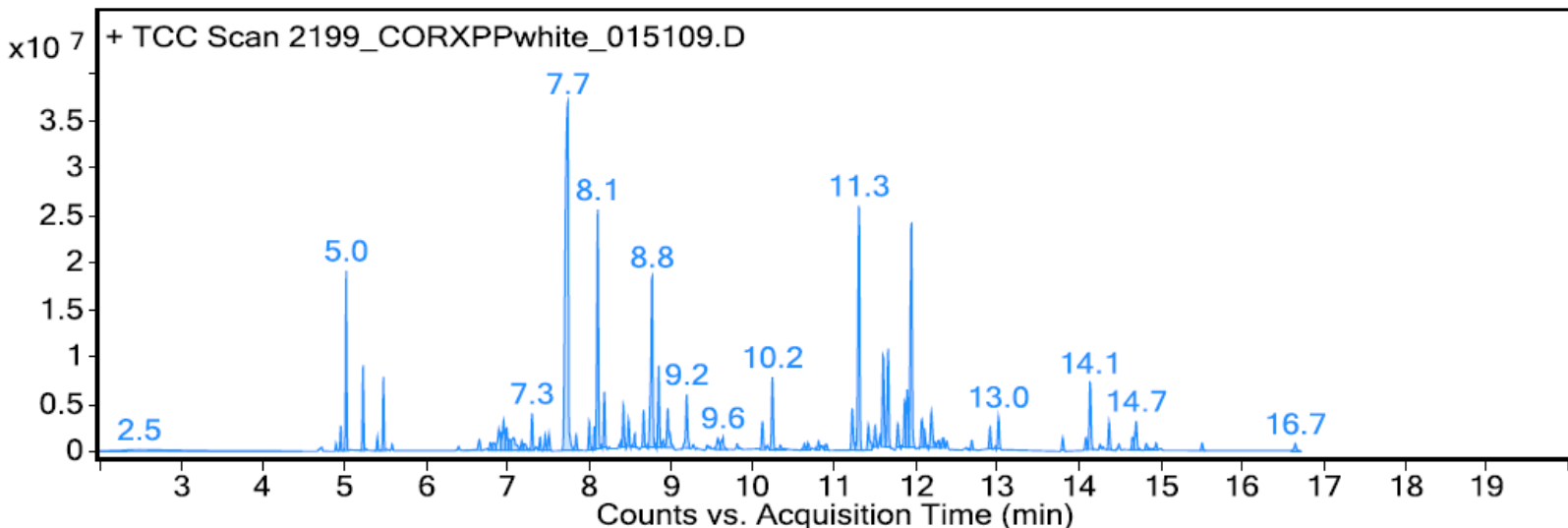
Sample: Cor-X polypropylene 4mm white board

Oddy test result: Temporary

Date collected: 06/20/2018

Technique used: SPME with a PDMS/DVB fiber; Agilent 7890B GC and 5977B MS fitted with a GL Sciences OPTIC-4 multimode inlet and LEAP PAL RTC autosampler; Pre-heated at 60°C for 20 minutes; fiber exposure at 60°C for 20 minutes; sample injected into 220°C inlet and crotrapped for 2 min at -15°C; GC ramped from 40°C to 225 °C at 10°C/min. Data analyzed in masshunter Qualitative. Samples > 80% match with a NIST library are reported.

VOCs not highlighted are because they were also observed in blanks: : (1) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.500	88.6	C8H17Cl	148.1	6856519	999062-62-7	2-Chloro-2-methyl-2-heptane
4.700	87.6	C5H10O2	102.1	883368	75-98-9	Propanoic acid, 2,2-dimethyl-
4.900	90.6	C6H18O3Si3	222.1	765623	541-05-9	Cyclotrisiloxane, hexamethyl-
5.000	95.0	C9H20	128.2	2494969	3074-71-3	Heptane, 2,3-dimethyl-
5.000	95.1	C9H20	128.2	17638100	2213-23-2	Heptane, 2,4-dimethyl-
5.200	94.1	C9H18	126.1	8764060	19549-87-2	2,4-Dimethyl-1-heptene
5.400	96.3	C9H20	128.2	1516967	3074-71-3	Heptane, 2,3-dimethyl-
5.500	95.1	C9H20	128.2	7646330	2216-34-4	Octane, 4-methyl-
5.600	95.3	C10H22	142.2	796603	2613-61-8	Heptane, 2,4,6-trimethyl-
6.400	82.7	C13H24O3	228.2	730425	1000382-53-9	Carbonic acid, nonyl prop-1-en-2-yl ester
6.900	87.4	C13H28	184.2	1677989	62108-23-0	Decane, 2,5,6-trimethyl-
6.900	91.0	C8H24O4Si4	296.1	1469961	556-67-2	Cyclotetrasiloxane, octamethyl-
7.200	87.2	C10H20	140.2	806457	293-96-9	Cyclodecane
7.300	93.5	C10H22	142.2	4507453	124-18-5	Decane
7.400	91.1	C11H24	156.2	1724863	17302-28-2	Nonane, 2,6-dimethyl-
7.500	91.2	C11H24	156.2	1960223	17302-28-2	Nonane, 2,6-dimethyl-
7.500	82.2	C7H7N	105.1	2210631	0-00-0	Benzylamine
7.700	86.4	C10H22O	158.2	72768978	112-30-1	1-Decanol
8.000	93.1	C12H26	170.2	3780328	52670-34-5	Octane, 2,3,6,7-tetramethyl-
8.100	81.1	C12H26	170.2	1132921	52670-34-5	Octane, 2,3,6,7-tetramethyl-
8.100	91.7	C12H26	170.2	34200817	112-40-3	Dodecane
8.200	92.6	C13H28	184.2	7402449	17301-32-5	Undecane, 4,7-dimethyl-
8.400	87.7	C13H28	184.2	849303	17301-32-5	Undecane, 4,7-dimethyl-
8.400	88.2	C12H24	168.2	6243160	112-41-4	1-Dodecene
8.500	88.6	C12H24	168.2	4521434	55170-80-4	1-Decene, 2,4-dimethyl-
8.600	88.6	C11H24	156.2	1463712	17302-23-7	Nonane, 4,5-dimethyl-
8.700	92.5	C13H28	184.2	6039053	62185-53-9	Nonane, 5-(2-methylpropyl)-
8.700	97.2	C8H8O2	136.1	3458365	93-58-3	Benzoic acid, methyl ester

8.800	92.2	C11H24	156.2	28191466	17302-23-7	Nonane, 4,5-dimethyl-
8.800	90.2	C12H26	170.2	11999102	112-40-3	Dodecane
9.000	92.6	C12H26	170.2	9413307	2980-69-0	Undecane, 4-methyl-
9.200	87.5	C15H32	212.3	1491703	3891-98-3	Dodecane, 2,6,10-trimethyl-
9.200	94.7	C10H30O5Si5	370.1	7661174	541-02-6	Cyclopentasiloxane, decamethyl-
9.300	90.0	C11H24	156.2	959988	17302-23-7	Nonane, 4,5-dimethyl-
9.400	83.2	C14H30O	214.2	737308	17071-54-4	Hexyl octyl ether
9.600	92.2	C12H26	170.2	1567060	1632-70-8	Undecane, 5-methyl-
9.600	97.0	C7H6O2	122.0	2213988	65-85-0	Benzoic acid
9.600	88.8	C12H26	170.2	884757	17312-44-6	2,3-Dimethyldecane
9.800	91.4	C12H26	170.2	883866	1002-43-3	Undecane, 3-methyl-
10.100	96.5	C12H24	168.2	4210011	112-41-4	1-Dodecene
10.200	95.5	C12H26	170.2	10635061	112-40-3	Dodecane
10.300	87.0	C10H20O	156.2	908425	112-31-2	Decanal
10.700	90.5	C14H30	198.2	874361	61141-72-8	Dodecane, 4,6-dimethyl-
10.800	93.9	C14H30	198.2	1293750	61141-72-8	Dodecane, 4,6-dimethyl-
10.900	91.7	C14H30	198.2	1104549	61141-72-8	Dodecane, 4,6-dimethyl-
11.200	89.6	C12H25Br	248.1	6814098	13187-99-0	2-Bromo dodecane
11.300	90.6	C14H30	198.2	38793785	61141-72-8	Dodecane, 4,6-dimethyl-
11.400	90.5	C14H30	198.2	4859953	61141-72-8	Dodecane, 4,6-dimethyl-
11.500	90.4	C15H32	212.3	3754069	31295-56-4	Dodecane, 2,6,11-trimethyl-
11.600	87.3	C12H36O6Si6	444.1	11353245	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.700	89.5	C11H24O	172.2	8261468	91337-07-4	2-Isopropyl-5-methyl-1-heptanol
11.800	88.4	C11H24O	172.2	4375845	91337-07-4	2-Isopropyl-5-methyl-1-heptanol
11.900	87.0	C11H24O	172.2	6527140	91337-07-4	2-Isopropyl-5-methyl-1-heptanol
11.900	90.1	C14H30	198.2	19910203	61141-72-8	Dodecane, 4,6-dimethyl-
12.100	91.3	C13H28	184.2	5518539	17301-32-5	Undecane, 4,7-dimethyl-
12.200	88.5	C13H28	184.2	8306719	31081-18-2	Nonane, 3-methyl-5-propyl-
12.300	90.6	C14H28	196.2	744151	51655-65-3	2-Butyl-1-decene
12.300	89.4	C20H42	282.3	2001703	112-95-8	Eicosane
12.400	88.1	C12H24O3	216.2	1565508	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.600	84.2	C14H30	198.2	773614	6418-41-3	Tridecane, 3-methyl-
12.700	92.9	C12H24O3	216.2	1692572	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.900	95.6	C14H28	196.2	3520858	1120-36-1	1-Tetradecene
13.000	94.5	C14H30	198.2	5141308	629-59-4	Tetradecane
13.800	80.0	C14H42O7Si7	518.1	2031130	107-50-6	Cycloheptasiloxane, tetradecamethyl-
14.100	89.0	C16H34O	242.3	2004432	999298-90-9	Tridecanol, 2-ethyl-2-methyl-
14.100	88.7	C16H34	226.3	10755631	544-76-3	Hexadecane
14.300	89.4	C16H34	226.3	936098	544-76-3	Hexadecane
14.400	81.1	C15H24O	220.2	4310526	999235-71-9	4P-2P
14.500	87.2	C24H50O	354.4	929609	1000406-38-6	Hexadecyl octyl ether
14.700	85.0	C19H40	268.3	1058837	629-92-5	Nonadecane
14.700	89.8	C16H34	226.3	4959696	544-76-3	Hexadecane
14.800	89.2	C15H32	212.3	1190880	31295-56-4	Dodecane, 2,6,11-trimethyl-
14.900	90.0	C20H42	282.3	1618447	638-36-8	Hexadecane, 2,6,10,14-tetramethyl-
15.500	91.8	C16H34	226.3	1158262	544-76-3	Hexadecane
16.700	90.7	C20H42	282.3	1402147	638-36-8	Hexadecane, 2,6,10,14-tetramethyl-